

What is claimed is:

1. A compound having the structure:

YZ-TCRO-ZY

where:

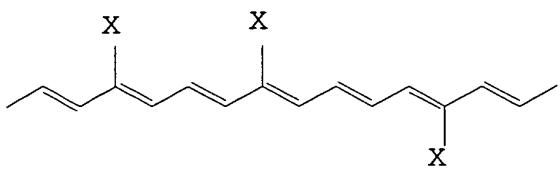
Y = a cation

Z = polar group which is associated with the cation, and

TCRO = trans carotenoid skeleton

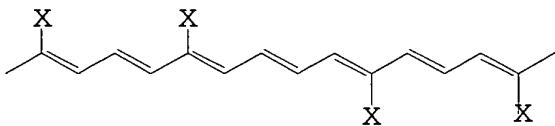
wherein said compound is not TSC.

2. A compound as in claim 1 wherein Y is a monovalent metal ion selected from the group consisting of Na^+ , K^+ , Li^+ , or an organic cation selected from the group consisting of R_4N^+ , R_3S^+ , where R is H, or $\text{C}_n\text{H}_{2n+1}$ where n is 1-10.
3. A compound as in claim 1 wherein Z is selected from the group consisting of a carboxyl (COO^-) group, a sulfate group (OSO_3^-) or a monophosphate group (OPO_3^-), (OP(OH)O_2^-), a diphosphate group, triphosphate or combinations thereof.
4. A compound as in claim 1 wherein TCRO is conjugated carbon-carbon double and single bonds containing carbon atoms wherein the 4 single bonds which surround a carbon-carbon double bond all lie in the same plane and said compound is linear.
5. A compound as in claim 1 wherein TCRO is



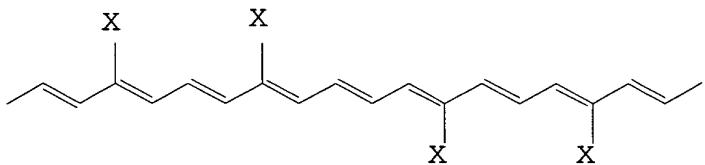
where X which can be the same or different, is H, a linear or branched group having 10 or less carbons optionally containing a halogen, or a halogen.

6. A compound as in claim 1 wherein TCRO is



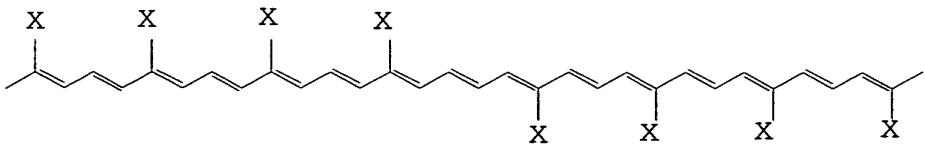
where X which can be the same or different, is H, a linear or branched group having 10 or less carbons optionally containing a halogen, or a halogen

7. A compound as in claim 1 wherein TCRO is



where X which can be the same or different, is H, a linear or branched group having 10 or less carbons optionally containing a halogen, or a halogen.

8. A compound as in claim 1 wherein TCRO is



where X which can be the same or different, is H, a linear or branched group having 10 or less carbons optionally containing a halogen, or a halogen.

9. A method of solubilizing a BTCS having the structure



where:

Y = a cation

Z = a polar group which is associated with the cation, and

TCRO = trans carotenoid skeleton

comprising the steps of:

- a) preparing a dilute solution of sodium carbonate or sodium bicarbonate,
- b) adding said dilute solution to deionized water to raise the pH to 7 or above,
- c) adding a BTCS to the solution of step b).

10. A method of solubilizing a BTCS having the structure



where:

Y = a cation

Z = a polar group which is associated with the cation, and

TCRO = trans carotenoid skeleton

comprising the steps of:

- a) adding a BTCS to a saline solution,
- b) removing undissolved material.

11. A method of solubilizing a BTCS having the structure



where:

Y = a cation

Z = a polar group which is associated with the cation, and,

TCRO = trans carotenoid skeleton.

comprising the steps of:

- a) adding a base to water to make a basic solution,
- b) adding a BTCS to said solution.

12. A method of solubilizing a BTCS having the structure

YZ-TCRO-ZY

where:

Y = a cation

Z = a polar group which is associated with the cation, and

TCRO = trans carotenoid skeleton

comprising the steps of:

- a) preparing deionized water,
- b) adding a BTCS to the solution of step a).

13. A method as in claim 9, 10, 11 or 12 wherein said compound is trans sodium crocetinate.

14. A method of increasing the diffusivity of oxygen in a mammal comprising administering to a mammal a therapeutically effective amount of a compound having the formula:

YZ-TCRO-ZY

where:

Y = a cation

Z = a polar group which is associated with the cation, and

TCRO = trans carotenoid skeleton,

wherein said compound is not TSC.

15. A method as in claim 14 wherein said administration is by inhalation.

16. A method of treating respiratory disease comprising administering to a mammal in need of treatment a therapeutically effective amount of a compound having the formula:

YZ-TCRO-ZY

where:

Y = a cation

Z = a polar group which is associated with the cation, and

TCRO = trans carotenoid skeleton,

wherein said compound is not TSC.

17. A method of treating emphysema comprising administering to a mammal in need of treatment a therapeutically effective amount of a compound having the formula

YZ-TCRO-ZY

where:

Y = a cation

Z = a polar group which is associated with the cation, and

TCRO = trans carotenoid skeleton,

wherein said compound is not TSC.

18. A method of treating hemorrhagic shock comprising administering to a mammal in need of treatment a therapeutically effective amount of a compound having the formula

YZ-TCRO-ZY

where:

Y = a cation

Z = a polar group which is associated with the cation, and

TCRO = trans carotenoid skeleton,

wherein said compound is not TSC.

19. A method of treating cardiovascular disease comprising administering to a mammal in need of treatment a therapeutically effective amount of a compound having the formula

YZ-TCRO-ZY

where:

Y = a cation

Z = a polar group which is associated with the cation, and

TCRO = trans carotenoid skeleton,

wherein said compound is not TSC.

20. A method of treating atherosclerosis comprising administering to a mammal in need of treatment a therapeutically effective amount of a compound having the formula

YZ-TCRO-ZY

where:

Y = a cation

Z = a polar group which is associated with the cation, and

TCRO = trans carotenoid skeleton,

wherein said compound is not TSC.

21. A method of treating asthma comprising administering to a mammal in need of treatment a therapeutically effective amount of a compound having the formula

YZ-TCRO-ZY

where:

Y = a cation

Z = a polar group which is associated with the cation, and

TCRO = trans carotenoid skeleton,

wherein said compound is not TSC.

22. A method of treating spinal cord injuries comprising administering to a mammal in need of treatment a therapeutically effective amount of a compound having the formula

YZ-TCRO-ZY

where:

Y = a cation

Z = a polar group which is associated with the cation, and

TCRO = trans carotenoid skeleton,

wherein said compound is not TSC.

23. A method of treating cerebral edema comprising administering to a mammal in need of treatment a therapeutically effective amount of a compound having the formula

YZ-TCRO-ZY

where:

Y = a cation

Z = a polar group which is associated with the cation, and

TCRO = trans carotenoid skeleton,

wherein said compound is not TSC.

24. A method of treating papillomas comprising administering to a mammal in need of treatment a therapeutically effective amount of a compound having the formula

YZ-TCRO-ZY

where:

Y = a cation

Z = a polar group which is associated with the cation, and

TCRO = trans carotenoid skeleton,

wherein said compound is not TSC.

25. A method of treating hypoxia comprising administering to a mammal in need of treatment a therapeutically effective amount of a compound having the formula

YZ-TCRO-ZY

where:

Y = a cation

Z = a polar group which is associated with the cation, and

TCRO = trans carotenoid skeleton,

wherein said compound is not TSC.

26. A method of synthesizing a BTCS compound having the formula

YZ-TCRO-ZY

where:

Y = a cation

Z = a polar group which is associated with the cation, and

TCRO = trans carotenoid skeleton,

comprising the steps of:

- a) coupling a symmetrical dialdehyde containing conjugated carbon-carbon double bonds with a triphenylphosphorane,
- b) saponifying the product of step a).

27. A method as in claim 26 wherein the coupling of step a) is made using [3-carbomethoxy-2-buten-1-ylidene]triphenylphosphorane.

28. A method as in claim 26 wherein the product of step a) is saponified using a solution of NaOH and methanol.

29. A method as in claim 26 wherein after step a) is the step of isolating the desired product of the coupling reaction.

30. A method of saponifying a symmetrical diester containing conjugated carbon-carbon double bonds to form a BTCS, comprising the steps of:

- a) solubilizing the symmetrical diester containing conjugated carbon-carbon double bonds with a compound selected from the group consisting of methanol, ethanol, propanol and isopropanol, and
- b) mixing the solution of step a) with a base.

31. A method as in claim 30 wherein the base is selected from the group consisting of NaOH, KOH, and LiOH.

32. A method as in claim 30 wherein the diester is saponified using methanol and NaOH.

33. A BTCS compound synthesized according to Claim 26.

34. A BTCS composition wherein absorbency of the highest peak which occurs in the visible wave length range divided by the absorbency of the peak which occurs in the UV wave length range is greater than 7.5.

35. A TSC composition wherein absorbency of the highest peak which occurs in the visible wave length range divided by the absorbency of the peak which occurs in the UV wave length range is greater than 7.5.

36. A method of increasing the diffusivity of oxygen in a mammal comprising administering to a mammal a therapeutically effective amount of BTCS wherein absorbency of the highest peak which occurs in the visible wave length range divided by the absorbency of the peak which occurs in the UV wave length range is greater than 7.5.

37. A method of treating emphysema comprising administering to a mammal in need of treatment a therapeutically effective amount of BTCS wherein absorbency of the highest peak which occurs in the visible wave length range divided by the absorbency of the peak which occurs in the UV wave length range is greater than 7.5.

38. A method of treating hemorrhagic shock comprising administering to a mammal in need of treatment a therapeutically effective amount of BTCS wherein absorbency of

the highest peak which occurs in the visible wave length range divided by the absorbency of the peak which occurs in the UV wave length range is greater than 7.5.

39. A method as in claim 36, 37 or 38 wherein the BTCS is TSC.

40. A method of increasing the diffusivity of oxygen in a mammal comprising administering to a mammal by inhalation a therapeutically effective amount of TSC.

41. An inhaler containing a BTCS compound having the structure:

YZ-TCRO-ZY

where:

Y = a cation

Z = polar group which is associated with the cation, and

TCRO = trans carotenoid skeleton.

42. An inhaler as in Claim 40 wherein said BTCS compound is TSC.

43. A method of converting an isomeric mixture of olefinic dialdehydes into the all trans aldehyde comprising isomerizing said isomeric mixture of dialdehydes with a sulfinic acid in a solvent.

44. A method as in claim 43 wherein said sulfinic acid has the formula RSO₂H where R is C1 through C10 straight or branched alkyl group or an aryl group.

45. A method as in claim 43 where the solvent is selected from the group consisting of 1,4-dioxane, tetrahydrofuran or dialkyl ether wherein the alkyl group is a C1 through C10 straight or branched alkyl group.

46. A method as in claim 43 wherein said sulfinic acid is para-toluenesulfinic acid and said solvent is 1,4-dioxane.

47. A method as in claim 43 wherein said olefinic dialdehyde is 2,7-dimethyl-2,4,6-octatrienedial.

48. A method as in claim 43 wherein said olefinic dialdehyde is 2,7-dimethyl-2,4,6-octatrienedial, said sulfinic acid is para-toluenesulfinic acid and said solvent is 1,4-dioxane.

49. A method of treating ischemia comprising administering to a mammal in need of treatment a therapeutically effective amount of a compound having the formula:



where:

Y = a cation

Z = a polar group which is associated with the cation, and

TCRO = trans carotenoid skeleton,

wherein said compound is not TSC.

50. A method of treating traumatic brain injury comprising administering to a mammal in need of treatment a therapeutically effective amount of a compound having the formula



where:

Y = a cation

Z = a polar group which is associated with the cation, and

TCRO = trans carotenoid skeleton,

wherein said compound is not TSC.

51. A method of enhancing performance of a mammal comprising administering to said mammal a therapeutically effective amount of a compound having the formula:



where:

Y = a cation

Z = a polar group which is associated with the cation, and

TCRO = trans carotenoid skeleton.

52. A method of treating complications of diabetes comprising administering to a mammal in need of treatment a therapeutically effective amount of a compound having the formula



where:

Y = a cation

Z = a polar group which is associated with the cation, and

TCRO = trans carotenoid skeleton.

53. A method of treating Alzheimer's disease comprising administering to a mammal in need of treatment a therapeutically effective amount of a compound having the formula



where:

Y = a cation

Z = a polar group which is associated with the cation, and

TCRO = trans carotenoid skeleton.

54. A method of treating ischemia in a mammal comprising administering to a mammal a therapeutically effective amount of BTCS wherein absorbency of the highest peak which occurs in the visible wave length range divided by the absorbency of the peak which occurs in the UV wave length range is greater than 7.5.

55. A method of treating traumatic brain injury comprising administering to a mammal in need of treatment a therapeutically effective amount of BTCS wherein absorbency of

the highest peak which occurs in the visible wave length range divided by the absorbency of the peak which occurs in the UV wave length range is greater than 7.5.

56. A method of enhancing performance comprising administering to a mammal an effective amount of BTCS wherein absorbency of the highest peak which occurs in the visible wave length range divided by the absorbency of the peak which occurs in the UV wave length range is greater than 7.5.

57. A method of treating diabetes comprising administering to a mammal in need of treatment a therapeutically effective amount of BTCS wherein absorbency of the highest peak which occurs in the visible wave length range divided by the absorbency of the peak which occurs in the UV wave length range is greater than 7.5.

58. A method of treating Alzheimer's disease comprising administering to a mammal in need of treatment a therapeutically effective amount of BTCS wherein absorbency of the highest peak which occurs in the visible wave length range divided by the absorbency of the peak which occurs in the UV wave length range is greater than 7.5.

59. A method as in claim 54, 55, 56, 57 or 58 wherein the BTCS is TSC.

60. A method of treating, preventing or reducing the amount of ischemia resulting from surgery of a mammal comprising administering to a mammal before, during or after surgery a therapeutically effective amount of BTCS.